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May 4, 2001

BOX PCT
Commissioner for Patents
Washington, D.C. 20231

PCT/JP99/04950
-filed September 10, 1999

Re: Application of Shiro IWATANI, Hirofumi WATANABE and Tatsuki KOUWA
CONTROLLER FOR A.C. GENERATOR FOR VEHICLE
Our Ref: Q64322

Dear Sir:

The following documents and fees are submitted herewith in connection with the above application for the purpose of entering the National stage under 35 U.S.C. § 371 and in accordance with Chapter I of the Patent Cooperation Treaty:

☑ an English translation of the International Application.

☑ three (3) sheets of drawings.

☑ Information Disclosure Statement and a Form PTO-1449.

The Declaration and Power of Attorney, Assignment, will be submitted at a later date.

It is assumed that copies of the International Application, the International Search Report, the International Preliminary Examination Report, and any Articles 19 and 34 amendments as required by § 371(c) will be supplied directly by the International Bureau, but if further copies are needed, the undersigned can easily provide them upon request.

Assignment for published patent application is: **MITSUBISHI DENKI KABUSHIKI KAISHA.**

The Government filing fee is calculated as follows:

Total claims	4	-	20	=		x	$18.00	= $.00
Independent claims	1	-	3	=		x	$80.00	= $.00
Base Fee								$860.00
TOTAL FEE								$860.00

A check for the statutory filing fee of $860.00 is attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17 and 1.492 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Respectfully submitted,

Robert J. Seas, Jr.
Registration No. 21,092

RJS/amt

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Description

CONTROLLER FOR A.C. GENERATOR FOR VEHICLE

Technical Field

The present invention relates to an electronic control circuit for controlling generator output, which is accommodated in a vehicle-mounted A.C. generator, and is in the form of a monolithic IC chip on a ceramic substrate.

Background Art

Heretofore, as a controller, for an A.C. generator in a vehicle in which discrete components are employed as circuit elements to be mounted onto a wiring board, a controller is known which has a circuit configuration shown in Fig. 3. This controller includes: an A.C. generator 1 having an armature coil 101 for driving an engine and for starting the generating operation of electrical energy, and a field coil 102; a rectifier 2 for taking out an output of generating electrical energy from the armature coil 101 to rectify the output, which is supplied to batteries 4 or to an electrical load (not shown); and a controller 3 having a voltage regulator 3a for detecting the voltage developed across the terminals of the batteries 4 to adjust the output voltage of the A.C. generator 1 on the basis of the voltage thus detected and a field current restricting unit 3b for detecting the field current caused to flow through the field coil 102 to restrict the field current on the basis of the detected current.

Reference numeral 5 indicates a key switch for starting the engine. This key switch 5 is turned ON so that the current flows through the field coil 102 from the batteries 4 to carry out the initial excitation.

The voltage regulator 3a is configured in such a way as to include: a constant voltage circuit in which an operating resistor 301 and a Zener diode 302 are electrically connected in series between the positive electrode of the batteries 4 and the earth through the key switch 5 to fetch a constant voltage A, which is determined on the basis of the breakdown voltage of the Zener diode 302, from a connection point P between the operating resistor 301 and the Zener diode 302; a voltage dividing circuit having voltage dividing resistors 303 and 304, which are electrically connected in series between an output terminal 201 of a positive electrode and an output terminal 202 of a negative electrode of the rectifier 2 to divide the output voltage of the rectifier 2; a first comparator 307 for applying a divided voltage Vd from the voltage dividing circuit to an input terminal (-) of the negative side and for applying a fixed reference voltage V_{REF1} to an input terminal (+) of the positive side to make H or L the logical level at the output terminal in accordance with the magnitude relationship between the divided voltage Vd and the reference voltage V_{REF1}; an output transistor 311 which is turned ON at the time when the logical level at the output terminal of the first comparator 307 has become H

to cause the field current to flow through the field coil 102 from the batteries 4; a suppression diode 310 which is electrically connected in reverse between a positive side line and a collector of the output transistor 311 to suppress a surge current which occurs at the time when shutting off the field current; and a base resistor 309 which is electrically connected between the output side of the key switch 5 and the base of the output transistor 311 to restrict a base current which is caused to flow through the base of the output transistor 311 at the time when carrying out the initial excitation of the field coil 102.

The field current restricting unit 3b includes: a voltage dividing circuit having voltage dividing resistors 305 and 306 for dividing a constant voltage A at a predetermined resistance ratio to generate a predetermined reference voltage V_{REF2}; a field current detecting resistor 312 connected between an emitter of the output transistor 311 and the earth for converting the field current flowing through the emitter into a voltage V1 to detect the voltage V1 thus obtained; and a second comparator 308 for applying the reference voltage V_{REF2} to an input terminal (+) of the positive side and for applying the voltage V1 to an input terminal (-) of the negative side to make L the logical level at the output terminal at the time when the voltage V1 has become higher than the reference voltage V_{REF2}.

Now, the description hereinbelow will be given with respect

to the outline of the operation in the conventional controller for an A.C. generator for a vehicle.

After having started the engine, the divided voltage Vd as a criterion of the terminal voltage of the batteries 4 rises above the reference voltage V_{REF1} to provide the over-charging state, the logical level at the output terminal of the first comparator 307 goes to L to turn OFF the output transistor 311 so that the field current to the field coil 102 is shut off, which reduces the output of the electrical energy generation.

When the terminal voltage of the batteries 4 has been reduced and also the divided voltage Vd has become lower than the reference voltage V_{REF1}, the logical level at the output terminal of the first comparator 307 goes to H to turn ON the output transistor 311. As a result, the current flowing loop consisting of the batteries 4, the field coil 102, the output transistor 311, the field current detecting resistor 312, and the earth is formed so that the field current is caused to flow from the batteries 4 to the field coil 102 to carry out the generation of electrical energy, and also the output of the generation of electrical energy is rectified through the rectifier 2 to be supplied to the batteries 4 which are in turn charged with the fixed voltage 14.5 V for example.

In this way, the output transistor 311 is turned repeatedly ON/OFF in accordance with the drop and the rise of the voltage developed across the terminals of the batteries 4 to intermittently

control the field current to so that the terminal voltage is maintained at a fixed value.

The surge current which is generated through the field coil 102 along with the interruption of the field current is suppressed by the suppression diode 310 to mitigate the influence thereof exerted on the electronic circuit.

However, if the line through which the terminal voltage of the batteries 4 is detected is cut in the voltage regulator 3a so that the divided voltage Vd becomes zero, for example, then the logical level of the output of the first comparator 307 continues to be H, and hence the A.C. generator 1 starts to cause to flow the excessive field current through the output transistor 311 in order to make the divided voltage Vd the reference voltage V_{REF1}.

At this time, the field current is caused to flow through the field current detecting resistor 312 to generate the voltage drop of the voltage V1. Then, the voltage V1 is applied to the negative side input terminal (-) of the second comparator 308. The reference voltage V_{REF2} which is used to judge the excessive field current is applied to the positive side input terminal (+) of the second comparator 308. At the time when the voltage V1 has become higher than the reference voltage V_{REF2}, the logical level at the output terminal of the second comparator 308 goes to L.

For this reason, the output at the logical level H of the first comparator 307 is absorbed by the output terminal of the second

comparator 308, whereby the base current of the output transistor 311 is shut off, and the field current is also shut off to stop the generation of electrical energy to prevent the burning of the A.C. generator.

If the discrete components such as resistors, capacitors and semiconductor devices are mounted onto the printed board as in the method of mounting the electronic apparatus in the conventional controller, then a large mounting area is required and the scale of the whole controller becomes large.

In addition thereto, since the high accuracy is required for the output control of the vehicle A.C. generator along with the promotion of the electronics for the vehicle control, the complexity and the high density of the electronic circuit in the controller are unavoidable.

Therefore, in the case where the discrete components are mounted to the printed board to configure such an electronic circuit, there arises the inconvenience that the scale of the whole controller becomes so large as to restrict the miniaturization of the A.C. generator.

In the light of the foregoing, the present invention has been made in order to solve the above-mentioned problems associated with the prior art, and hence it is therefore an object of the present invention to obtain a controller for an A.C. generator in which the circuit board can be miniaturized and the difficulty of building

the circuit board into the body of the A.C. generator is removed, and also a constant of a field current detecting resistance can be readily changed in correspondence with the field current of the A.C. generator.

Disclosure of the Invention

1. The present invention includes: batteries each of which is charged with electric charges on the basis of an output of generation of electrical energy of an A.C. generator having a field coil; voltage regulating means for regulating a current, which is caused to flow through the field coil, on the basis of the detection result of a voltage developed across the terminals of the batteries due to an output voltage of the A.C. generator into an fixed output value of generation of electrical energy of the A.C. generator; and field current restricting means for detecting a current flowing through the field coil by means of a field current detecting resistor, which restricts the current to a predetermined value in correspondence to the detection result, wherein the field current detecting resistor is formed in the form of a thick film printed resistor, and with respect to each of the means other than the thick film printed resistor, electronic circuits are configured in the form of an integrated circuit.

2. According to the present invention, the thick film printed resistor and the integrated circuits are formed on an insulating board.

3. According to the present invention, a resistor body constituting the thick film printed resistor is trimmed to adjust the resistance value thereof and to adjust the field current detection value.

4. According to the present invention, failure alarm means for detecting a failure of the A.C. generator on the basis of the output of the A.C. generator to give an alarm is provided in the form of an integrated circuit.

Brief Description Of The Drawings

Fig. 1 is a diagram showing the construction when a control unit in a controller of an A.C. generator for a vehicle according to an embodiment 1 of the present invention is configured in the form of an integrated circuit;

Fig. 2 is a circuit diagram showing a configuration of a controller of an A.C. generator for a vehicle according to an embodiment 2 of the present invention; and

Fig. 3 is a circuit diagram showing a configuration of a controller of a conventional A.C. generator for a vehicle.

Best Mode For Carrying Out The Invention

Embodiment 1

The high accuracy is required for the output control of an A.C. generator for a vehicle along with the promotion of the electronics of the vehicle control. In response to this requirement, the complexity of the electronic circuits in a

controller, and the high density of the circuit configuration in a substrate (board) resulting therefrom are unavoidable.

Now, in the present embodiment, as shown in Fig. 1, the respective electronic circuits, except for a field current detecting resistor 312, i.e., a voltage regulator 3a and a field current restricting unit 3b are integrated in the form of a monolithic IC chip 321 on a ceramic substrate 320 having a high heat radiating effect. In the ceramic substrate 320, signal I/O terminals 323 are formed through the patterning in the periphery of the monolithic IC chip 321. The signal I/O terminals 323 are electrically connected to the associated electrodes of the monolithic IC chip 321 through bonding wires 322, respectively.

Now, the field current detecting resistor 312 through which the high current is caused to flow and for which the high accurate resistance value is required is constituted by a thick film printed resistor body which is formed on the ceramic substrate utilizing the printing method.

The resistance value accuracy of the thick film printed resistor body depends on the printing accuracy for the resistor body. It is said that in the current technique, the upper limit of the resistance value accuracy is ± 20 %. However, the required accuracy of the resistance value is higher than value.

Therefore, in general, as the trimming method to adjust the resistance value of the thick film printed resistor body, there

is adopted the method wherein the laser beam is scanned on the resistor body to vaporize and remove a part, suffering the application of the laser beam, of the thick film printed resistor body.

As another trimming method, there is the sand blasting method wherein the powder of alumina is sprayed onto the resistor body to shave off a desired amount of resistor body.

In such a way, in the present embodiment 1, the electronic circuits except for the field current detecting resistor 312 in the field current restricting unit 3b are formed in the form of a monolithic IC chip on the ceramic substrate 320 respectively, and the field current detecting resistor 312 is formed on the ceramic substrate 320 by utilizing the printing method.

As a result, the circuits are integrated, whereby the size of the circuit substrate is reduced. In addition, the resistance value of the field current detecting resistor 312 which is formed on the ceramic substrate 320 by utilizing the printing method, even after the resistor body has been formed on the ceramic substrate 320 by utilizing the printing method, by utilizing the above-mentioned triming method, can readily be adjusted in accordance with the specification of the field current of the A.C. generator to be used.

Embodiment 2

In the above-mentioned embodiment 1, the electronic circuits

which constitute the voltage regulator 3a and the field current restricting unit 3b in the control unit 3 are integrated into the monolithic IC chip to be formed on the ceramic substrate 320. However, alternatively, there may also be adopted the configuration in which in addition to the electric circuit of the conventional control unit, an electronic circuit of a failure alarm 3c for giving the alarm for the failure of the A.C. generator is also integrated into the monolithic IC chip to be formed on the ceramic substrate 320, as shown in Fig. 2.

The failure alarm 3c in the present embodiment 2 includes: a diode 317 for rectifying the A.C. power generation output for one phase which has been fetched out from the armature coil 101 of the A.C. generator 1; a filter 313 for smoothing the power generation output thus rectified; a third comparator 314 for applying the smoothed power generation output (D.C. power generation output) to the positive side input terminal (+) and for applying a reference voltage V_{REF3} ($V_{REF1} > V_{REF2} > V_{REF3}$), which is used to judge the reduction of the power generation output resulting from the failure of the A.C. generator 1 to the negative side input terminal (-); an LED 315 which is electrically connected in series between the terminal through which the constant voltage A is applied and the output terminal of the third comparator 314; and a current restricting resistor 316.

If, as the operation of the failure alarm 3c, some failure

or other occurs in the A.C. generator 1, then the power generation outputs is reduced. After the power generation output for one phase has been fetched to be converted into the D.C. output through the diode 317 and the filter 313, it is inputted as the D.C. power generation output to the positive side input terminal (+) of the third comparator. The reference voltage V_{REF3} is applied to the negative input terminal (-) of the third comparator. The third comparator 314 compares the reference voltage V_{REF3} and the D.C. power generation output with each other. At a time point when the D.C. power generation output has become lower than the reference voltage V_{REF3}, the logical level at the output terminal goes to L. As a result, the current is caused to flow through the LED 315 and the current restricting resistor 316 by the constant voltage A, which lights the LED 315 to inform the operator of the failure of the generator whereby the failure of the A.C. generator can be readily recognized.

Industrial Applicability

According to the present invention, an electronic circuit of a control unit which is accommodated inside a vehicle-mounted A.C. generator,and adopted to control an output of the generator is formed as a monolithic IC chip on a ceramic substrate, whereby the size of the whole apparatus is reduced, and also a resistance value of a field current detecting resistor which has been formed on the ceramic substrate by utilizing the printing method is adjusted in accordance with the specifications of a field current of the A.C.

generator.

Claims

1. A controller for an A.C. generator for a vehicle, comprising:

batteries each of which is charged with electric charges on the basis of an output of generation of electrical energy of an A.C. generator having a field coil;

voltage regulating means for regulating a current, which is caused to flow through said field coil, on the basis of the detection result of a voltage developed across the terminals of said batteries due to an output voltage of said A.C. generator into an fixed output value of the generation of electrical energy of said A.C. generator; and

field current restricting means for detecting a current which is caused to flow through said field coil by means of a field current detecting resistor to restrict the current to a predetermined value in correspondence to the detection result,

wherein said field current detecting resistor is formed as a thick film printed resistor, and

wherein each of said means other than said thick film printed resistor is formed as an electronic circuit are configured in the form of an integrated circuit.

2. A controller for an A.C. generator for a vehicle according to claim 1, wherein said thick film printed resistor and

said integrated circuits are formed on an insulating board.

3. A controller for an A.C. generator for a vehicle according to claim 1, wherein a resistor body constituting said thick film printed resistor is trimmed to adjust the resistance value thereof and to adjust the field current detection value.

4. A controller for an A.C. generator for a vehicle according to claim 1, wherein a failure alarm means for detecting a failure of said A.C. generator on the basis of the output of said A.C. generator to give an alarm is provided in the form of an integrated circuit.

Abstract

A controller for an A.C. generator for a vehicle, includes: batteries each of which is charged with electric charges on the basis of an output of generation of electrical energy of an A.C. generator having a field coil; voltage regulating means for regulating a current, which is caused to flow through the field coil, on the basis of the detection result of a voltage developed across the terminals the batteries due to an output voltage of the A.C. generator into an fixed output value of the generation of electrical energy of the A.C. generator; and field current restricting means for detecting a current which is caused to flow through the field coil by means of a field current detecting resistor to restrict the current to a predetermined value in correspondence with the detection result, wherein the field current detecting resistor is formed as a thick film printed resistor, and wherein each of the means other than the thick film printed resistor is formed by an electronic circuit are in the form of an integrated circuit.

FIG. 1

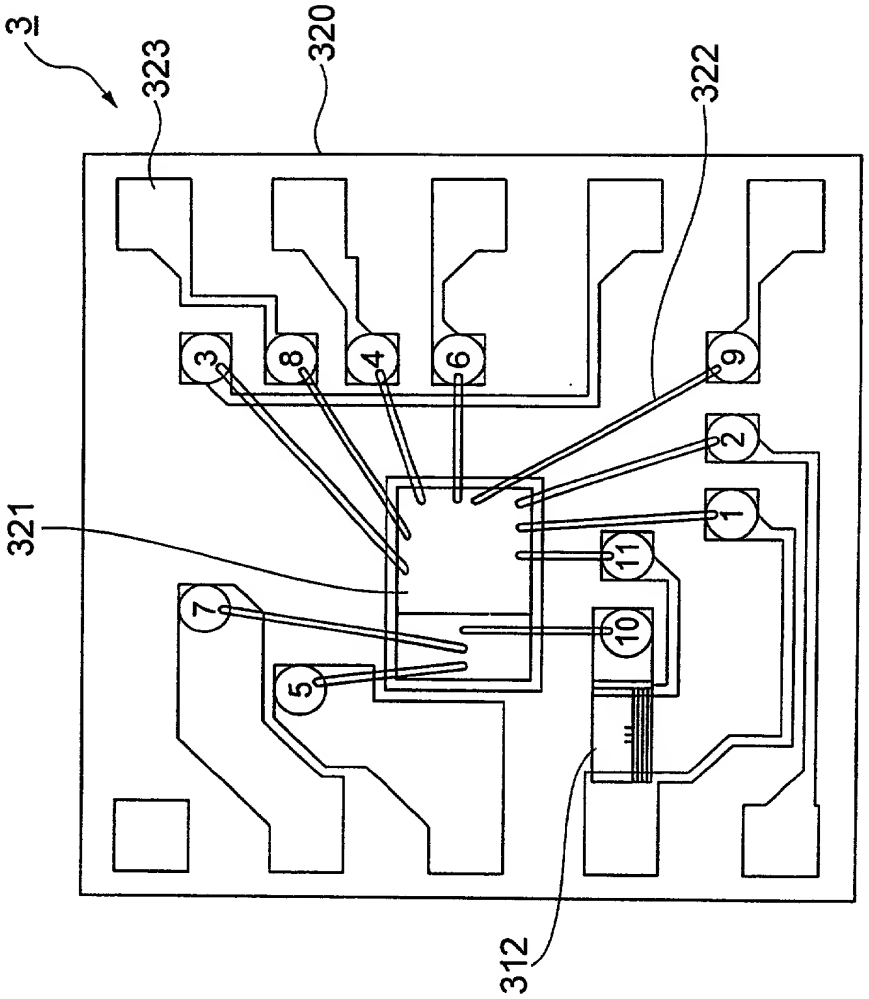


FIG. 2

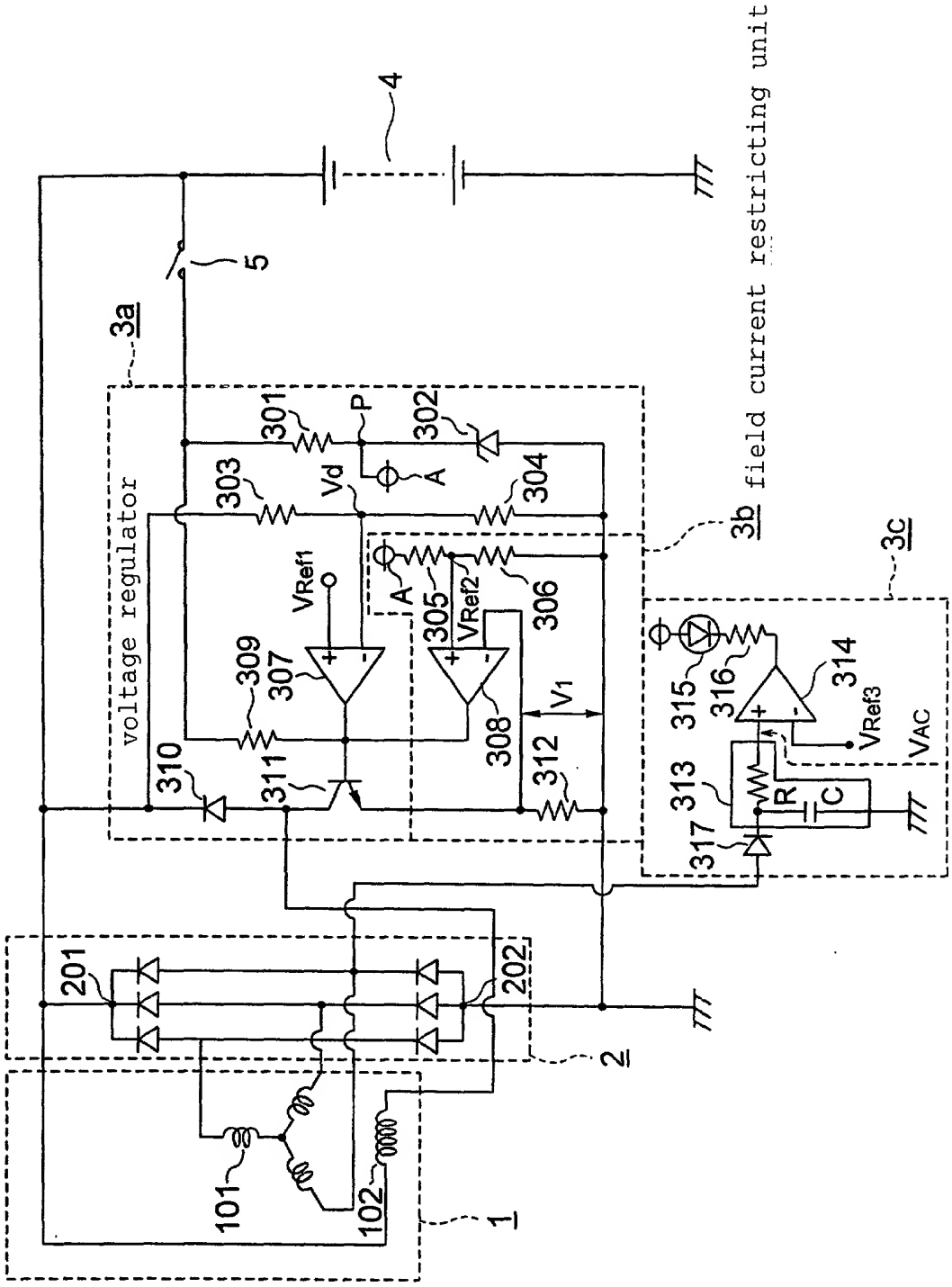
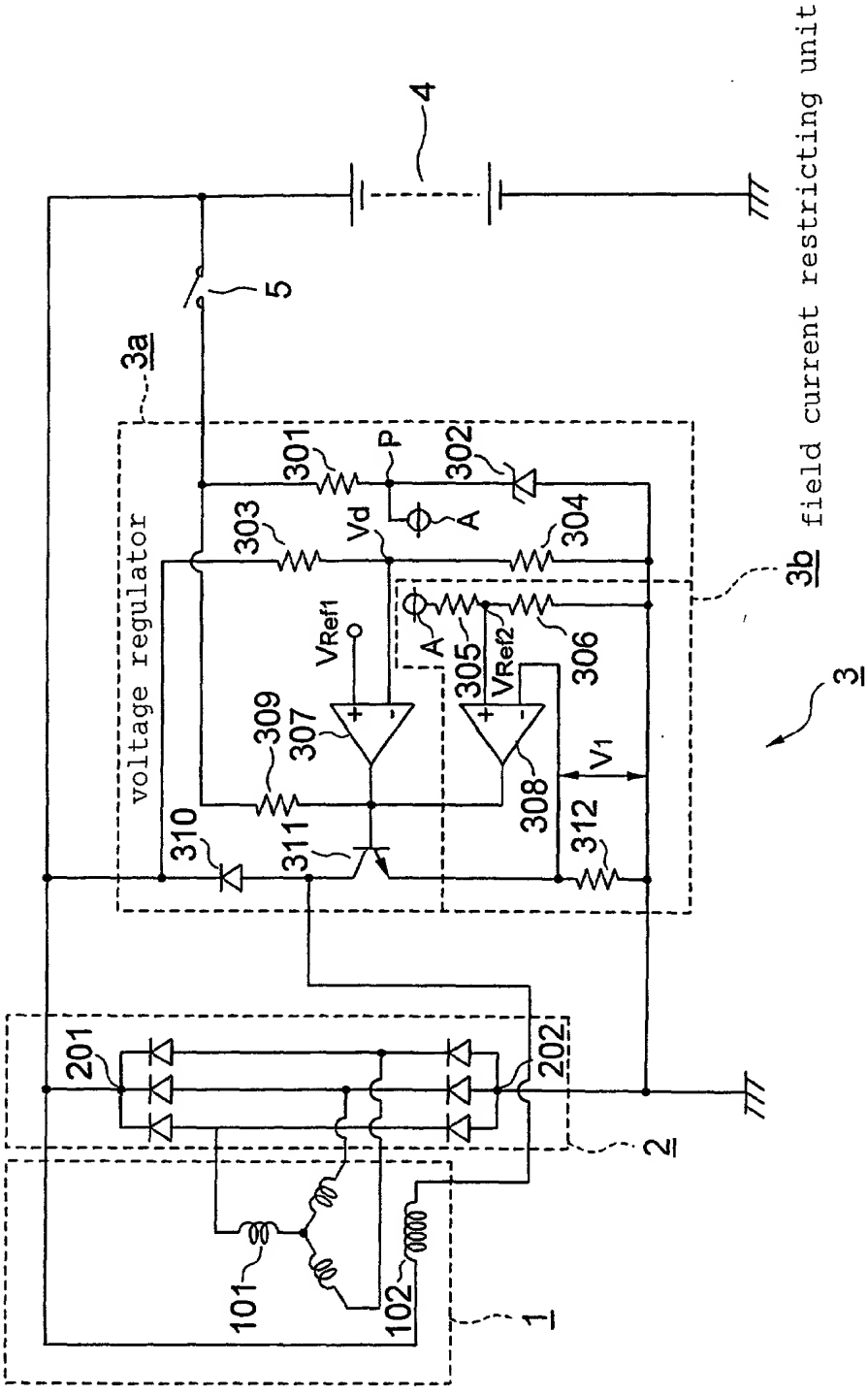

4
5
3a
voltage regulator
301
P
302
303
Vd
A
304
VRef1
309
307
A
305
VRef2
306
3b field current restricting unit
3c
310
311
308
V1
312
315
316
314
VRef3
VAC
313
R
C
317
201
202
2
101
102
1

FIG. 3


4
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3a
voltage regulator
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3b field current restricting unit
VRef1
A
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VRef2
306
3
309
307
308
V1
310
311
312
201
202
2
101
102
1

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

CONTROLLER FOR A.C. GENERATOR FOR VEHICLE

上記発明の明細書は、

☐ 本書に添付されています。

☐ ____月____日に提出され、米国出願番号または特許協定条約国際出願番号を_____とし、

（該当する場合）_____に訂正されました。

the specification of which

☐ is attached hereto.

☒ was filed on September 10, 1999

as United States Application Number or

PCT International Application Number

PCT/JP 99/04950 and was amended on

_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第35編119条（a）-（d）項又は365条（b）項に基づき下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365（a）項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Claimed 優先権主張 Yes はい	No いいえ
			☐	☐
			☐	☐

私は、第35編米国法典119条（e）項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条（c）に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration

委任状： 私は、下記発明者として、以下の代理人をここに選任し、本願の手続きを遂行すること並びにこれに関する一切の行為を特許商標局に対して行うことを委任する。
（代理人氏名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith *(list name and registration number)*

I hereby appoint John H. Mion, Reg. No. 18,879; Donald E. Zinn, Reg. No. 19,046; Thomas J. Macpeak, Reg. No. 19,292; Robert J. Seas, Jr., Reg. No. 21,092; Darryl Mexic, Reg. No. 23,063; Robert V. Sloan, Reg. No. 22,775; Peter D. Olexy, Reg. No. 24,513; Frank Osha, Reg. No. 24,625; Waddell A. Biggart, Reg. No. 24,861; Robert G. McMorrow, Reg. No. 19,093; Louis Gubinsky, Reg. No. 24,835; Neil B. Siegel, Reg. No. 25,200; David J. Cushing, Reg. No. 28,703; John R. Inge, Reg. No. 26,916; Joseph J. Ruch, Jr., Reg. No. 26,577; Sheldon I. Landsman, Reg. No. 25,430; Richard C. Turner, Reg. No. 29,710; Howard L. Bernstein, Reg. No. 25,665; Alan J. Kasper, Reg. No. 25,426; Kenneth J. Burchfiel, Reg. No. 31,333; Gordon Kit, Reg. No. 30,764; Susan J. Mack, Reg. No. 30,951; Frank L. Bernstein, Reg. No. 31,484; Mark Boland, Reg. No. 32,197; William H. Mandir, Reg. No. 32,156; Scott M. Daniels, Reg. No. 32,562; Brian W. Hannon, Reg. No. 32,778; Abraham J. Rosner, Reg. No. 33,276; Bruce E. Kramer, Reg. No. 33,725; Paul F. Neils, Reg. No. 33,102; and Brett S. Sylvester, Reg. No. 32,765, my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and request that all correspondence about the application be addressed to SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC, 2100 Pennsylvania Avenue, N.W., Washington, D.C. 20037-3202.

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Japanese Language Declaration

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